The MIT City Science Process

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The City Science Network is an international community of institutions and researchers that share the common goal of enabling more livable, equitable, and resilient communities. The network, started ten years ago, now includes ten international nodes including: Biobío, Chile; Guadalajara, Mexico; Toronto, Canada; Andorra; Gipuzkoa, Spain; Hamburg, Germany; Taipei, Taiwan; Shanghai, China; and Israel in addition to our lab at MIT in Cambridge. As a network we propose that transnational problems such as climate change and public health are best addressed in cities, one community at a time. Future cities, described as clusters of high-performing, entrepreneurial, and walkable communities, would allow for neighborhoods that aspire to achieve the following goals: zero commuting, zero energy, maximum creative collisions, maximum equity, and maximum public health. These communities will offer a unique combination of density, diversity, access, and public amenities to inspire, promote social interaction, ensure equity, and increase creative and entrepreneurial engagement[1].

In order to tackle these challenges and fulfill our shared vision we need a clear and yet flexible innovation framework. The City Science Process offers an approach for community-scale innovation. The five steps of the City Science Process are as follows:

Insight — Understanding Current Conditions
The process begins with comprehensive data collection and analysis to evaluate the current social, economic, and environmental landscape of an urban community. It utilizes a wide range of data sources, from telecom to social media data, to achieve a nuanced understanding of live/work dynamics, mobility behaviors, community values, and patterns of human interaction. These insights provide the evidence base for informed intervention design.

Transformation — Designing Interventions to Improve Performance
Based on identified needs, targeted interventions are developed to enhance social equity, economic opportunity, and environmental sustainability. These interventions encompass urban programming to promote entrepreneurship, community-scale autonomous mobility, hyper-efficient transformable housing, and distributed infrastructure for water, sanitation, power, and food production near the point of consumption.

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[1] Larson, K., et al. (2020). *City Science: How to design, implement, and measure innovations for community-scale impact*. MIT Media Lab.

Prediction — Simulating the Impact of Interventions
Advanced simulation tools predict how proposed interventions will impact human behavior, resource consumption, mobility patterns, and knowledge exchange. This includes the use of "human dynamics digital twins"—3D virtual environments populated by synthetic agents that accurately emulate complex urban behaviors.

Consensus — Facilitating Informed Community Decision-Making
Interactive community engagement platforms empower stakeholders to collaboratively shape a shared vision for the future. These CityScope tools incorporate AI-driven recommendation engines and generative visualization, enabling rapid scenario testing and iterative evaluation. This fosters more creative, inclusive, and evidence-based decision-making.

Governance — Enabling Dynamic, Incentive-Based Policy Frameworks
Moving beyond static zoning and conventional regulatory frameworks, City Science envisions adaptive, algorithmically guided governance systems that dynamically adjust incentives in real time to promote pro-social, high-performance urban development. Under continuous human oversight, these systems are designed to foster a self-regulating civic environment in which "civic homeostasis"—a dynamic equilibrium comparable to that of healthy natural ecosystems—can be achieved and sustained. In this model, housing, employment, amenities, and infrastructure achieve a responsive balance, and wealth creation is shared by community members.

Insight — Understanding Current Conditions

The process begins with comprehensive data collection and analysis to evaluate the current social, economic, and environmental landscape of an urban community. It utilizes a wide range of data sources, from telecom to social media data, to achieve a nuanced understanding of live/work dynamics, mobility behaviors, community values, and patterns of human interaction[2][3]. These insights provide the evidence base for informed intervention design.

Insights may include:

- Community resilience and vulnerabilities
- Live/work relationships and housing patterns

[2] Ratti, C., Pulselli, R.M., Williams, S., & Frenchman, D. (2006). *Mobile Landscapes: Using location data from cell phones for urban analysis*. Environment and Planning B.
[3] Santi, P., Resta, G., Szell, M., Sobolevsky, S., Strogatz, S. H., & Ratti, C. (2014). *Quantifying the benefits of vehicle pooling with shareability networks*. PNAS.

- Mobility behaviors and flows
- Social values and interaction patterns

Transformation — Designing Interventions to Improve Performance

Based on identified needs, targeted interventions are developed to enhance social equity, economic opportunity, and environmental sustainability. These interventions encompass urban programming to promote entrepreneurship, community-scale autonomous mobility, hyper-efficient transformable housing, and distributed infrastructure for water, sanitation, power, and food production near the point of consumption.

Interventions developed may include:

- **Mobility:** Introduction of ultra-lightweight, shared autonomous modes to reduce congestion, enhance accessibility, and ensure adaptable transit systems during emergencies.
- **Live/Work Spaces:** Design of transformable, hyper-efficient housing units that support remote work, affordability, and spatial flexibility, especially under quarantine scenarios.
- **Energy:** Deployment of distributed energy systems and microgrids to support net-zero energy communities.
- **Urban Design:** Creation of resilient, walkable neighborhoods with local access to resources, supporting entrepreneurship and sustainability.
- **Dynamic Zoning:** Transition from rigid land-use policies to algorithmic zoning mechanisms that adapt in real time to promote pro-social behavior and diverse, multifunctional urban cells[4].

Simulation — Forecasting the Impact of Interventions

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[4] Arbabi, H., & Mayfield, M. (2020). *Dynamic zoning for smart cities: The case for algorithmic planning*. Cities, 97, 102497.

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Behaviors may include:

- How residents interact with redesigned environments
- Patterns of resource consumption and exchange
- Shifts in mobility, livability, and social cohesion

Scenario testing enables data-driven, anticipatory design[5].

Consensus — Facilitating Informed Community Decision-Making

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Engagement may happen via use if the MIT CityScope platform, a real-time visualization and AI-supported scenario analysis. This can leverage the knowledge of a wide range of stakeholders to enable transparent, inclusive, and collaborative planning. Participants may:

- Explore trade-offs and alternatives
- Test and iterate solutions interactively
- Build consensus through shared understanding

This participatory process ensures solutions are rooted in local values and needs[6].

[5] Batty, M. (2018). *Digital twins*. Environment and Planning B: Urban Analytics and City Science, 45(5), 817–820.
[6] Larson, K., et al. (2016). *CityScope: A data-driven platform for urban decision-making*. MIT Media Lab.

Governance — Enabling Dynamic, Incentive-Based Policy Frameworks

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When appropriate resources are available, selected interventions are piloted in real-world contexts through **Living Labs**. These implementations serve to:

- Test and refine innovations
- Foster shared ownership and civic engagement
- Generate empirical data to inform policy and future deployments

This phase supports a transition toward long-term civic equilibrium, where urban systems remain adaptable and inclusive.

Real change at the scale of a community is complex and takes time. This process offers a methodology for researchers and communities to make incremental progress while keeping their focus on human-centered design. There is an opportunity for design, technology, and public policy to dramatically reduce the 70% of global greenhouse gases emitted in urban areas while simultaneously improving public health, innovation potential, and equity.

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[7] Hillier, B. (2007). *Space is the Machine: A Configurational Theory of Architecture*. Space Syntax.
[8] Moroni, S. (2019). *Ethics, Design and Planning of the Built Environment*. Springer.

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